Simpson

INSTRUMENTS THAT STAY ACCURATE

OPERATOR'S MANUAL

MODEL 479
FM-TV SIGNAL GENERATOR

SIMPSON ELECTRIC COMPANY
5200 W. Kinzie St., Chicago 44, Illinois, COl 1-1221
In Canada, Bach-Simpson, Ltd., London, Ontario

Price $1.50

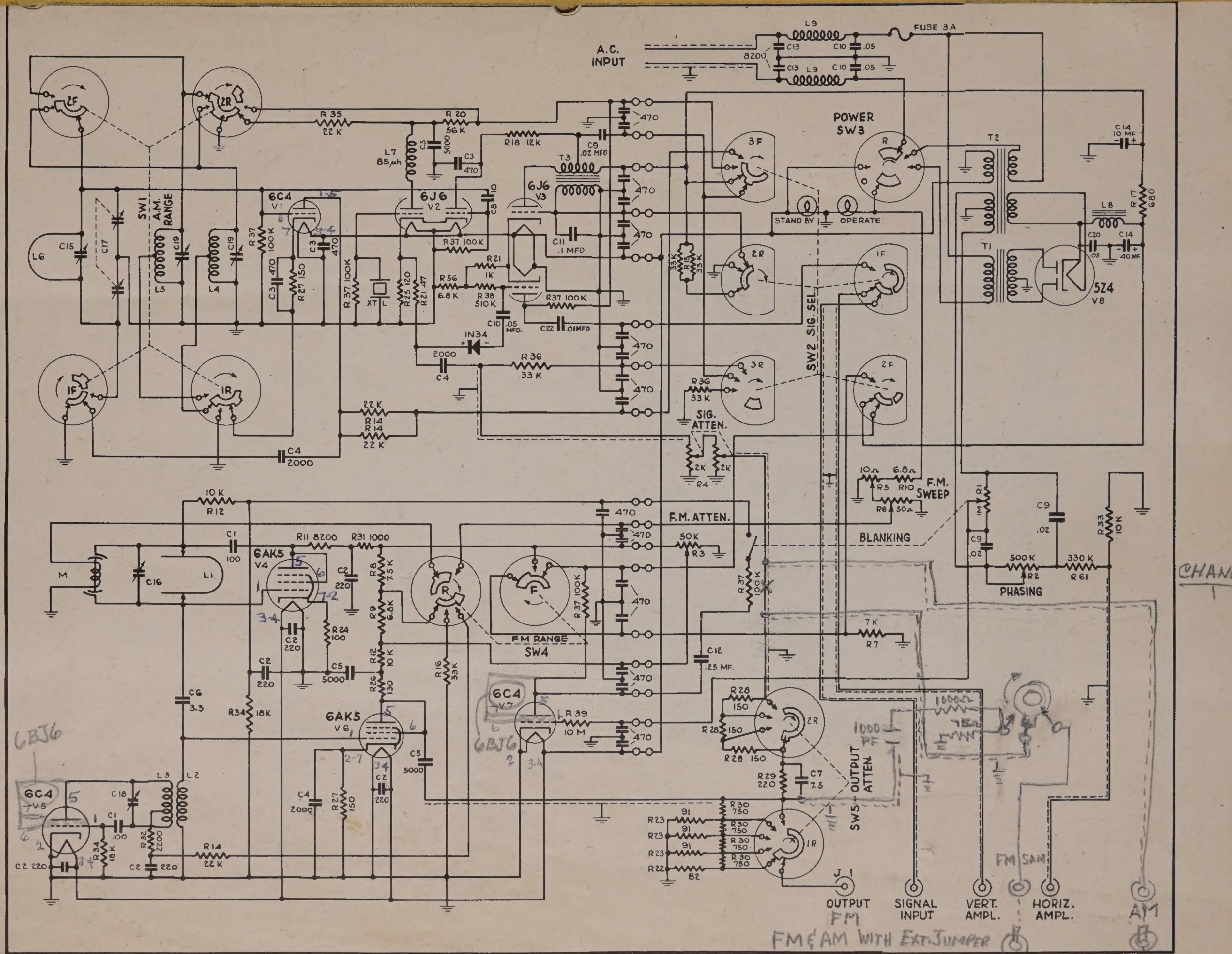

FIG. 19 SCHEMATIC DIAGRAM OF MODEL 479.

OPERATING INSTRUCTIONS - MODEL 479 TV-FM SIGNAL GENERATOR

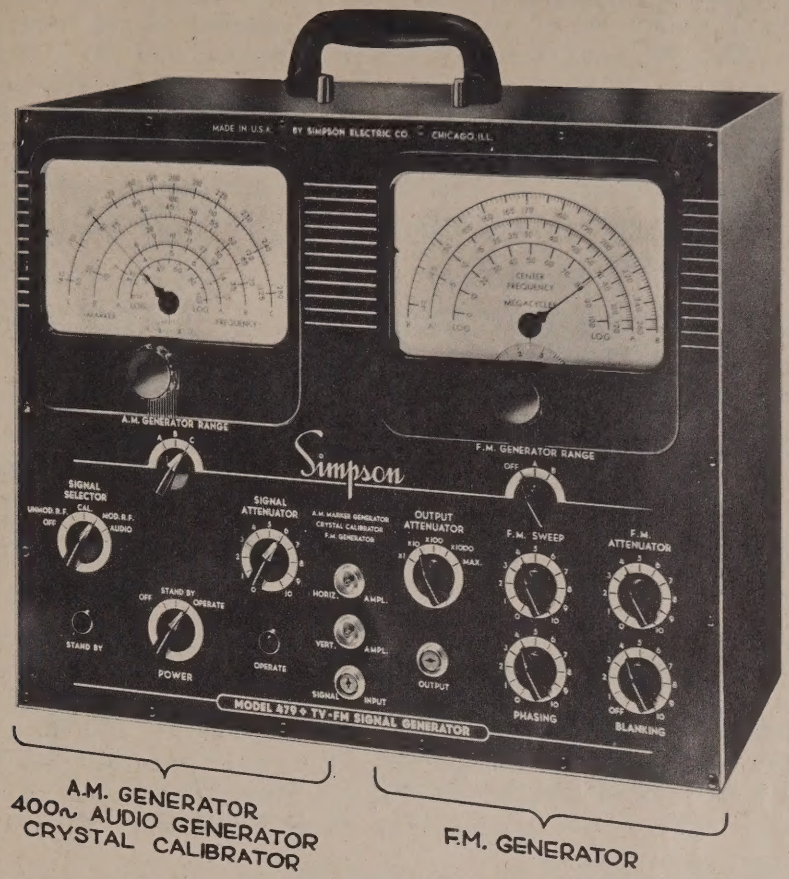

FIG. 1 THE MODEL 479 TV-FM SIGNAL GENERATOR

The Simpson Model 479 Signal Generator has been carefully designed to supply all of the necessary signal sources for the proper alignment and servicing of FM and TV receivers.

Both variable oscillator sections are provided with large, precision vernier dials having a 20:1 ratio and 1000 division logging scales. They are easy to read and easy to set to exact frequency.

Everything possible has been done to make the Model 479 the most accurate, flexible and convenient instrument available. Each part of this instrument has been carefully considered for long life and stability. Many of the most vital components are manufactured within our own plants in order to insure lasting accuracy and many years of uninterrupted service.

DESCRIPTION

The Model 479 is divided into two major sections. See Fig. 1.

The left hand section contains a three range R.F. Generator, crystal calibrator and 400 cycle audio oscillator.

The type of signal desired is selected by a SIGNAL SELECTOR switch (left). When this switch is in the OFF position the section is in-operative. In the UNMOD. RF position an ummodulated RF signal is available at the OUTPUT cable and controlled

through the SIGNAL ATTENUATOR (right) and the OUTPUT ATTENUATOR. In the CAL. POSITION, the 5MC crystal oscillator or one of its harmonics is mixed with the RF signal or one of its harmonics to produce a "beat" pattern on the oscilloscope and thus provides an accurate means of adjusting the RF signal to an exact frequency. (See Table 1.) In the MOD. RF position a 400 cycle modualted RF signal is available at the output cable and controlled through the SIGNAL ATTENUATOR and the OUTPUT ATTENUATOR. In the AUDIO position a 400 cycle audio signal is available at the output cable and controlled through the SIGNAL ATTENUATOR and the OUTPUT ATTENUATOR.

The AM GENERATOR RANGE switch (upper center) together with the tuning dial selects the desired RF signal.

Band A Fundamental 3.3-7.8 MC	second harmonic 6.6-15.6 MC
Band B Fundamental 15-38 MC	second harmonic 30-76 MC
Band C Fundamental 75-125 MC	second harmonic 150-250 MC

The POWER switch (lower center) controls the power input to the Model 479. In the OFF position the entire instrument is turned off. In the STAND BY position all tube heaters are on but no plate voltage is applied. In the OPERATE position the plate supply is turned on. The green light (left) is on in the STAND BY position and the red light (right) indicates the OPERATE position.

The right hand section of the Model 479 contains a Frequency Modulated signal generator, a 140 MC fixed frequency oscillator, mixer, phasing and blanking circuits.

The fundamental range of the FM generator is 140 to 260 MC and is available at the output when the FM GENERATOR RANGE switch (upper center) is in position B. In position A the 140 MC fixed oscillator is in operation and is mixed with the FM generator to produce difference frequencies from 2-120 MC. When in the OFF position both oscillators are inoperative.

The FM SWEEP control (center) regulates the amount of frequency sweep from zero to over 15 megacycles.

The FM ATTENUATOR (upper right) controls the output from the FM section.

The PHASING control (lower center) adjusts the horizontal sweep of the oscilloscope to coincide with the frequency sweep of the oscillator in order to superimpose the return trace on the forward trace.

The BLANKING control injects a negative pulse into the FM oscillator circuit in such a manner that oscillation is stopped during the return trace of the oscilloscope thus producing a base line and a single trace response curve on the cathode ray tube.

The OUTPUT ATTENUATOR is a step attenuator through which all signals must pass into the OUTPUT jack directly below it.

The OUTPUT ATTENUATOR has a constant output impedance of 75 ohms in all positions except MAX. In this position the impedance may vary from 175 ohms to 450 ohms depending upon the position of the SIGNAL ATTENUATOR.

Four cables are supplied for making connections between the Model 479, the receiver and the oscilloscope.

The OUTPUT cable which conducts the selected signal to the receiver input in-

cludes a variable termination network which may be quickly adapted to the receiver input impedance or to provide a .02 Mfd. series condenser for use on circuits containing a DC component. No external matching networks or coupling condensers are necessary. See Fig. 14 and Table 2.

After passing through the receiver the amplified and demodulated signal is returned to the Model 479 through the SIGNAL INPUT cable where it passes through the SIGNAL SELECTOR switch to the VERT. AMPL. cable and so to the vertical amplifier of the oscilloscope. This arrangement was designed to simplify the alignment operation by internal switching of the oscilloscope input.

When the SIGNAL SELECTOR switch is in the UNMOD. RF, MOD. RF or AUDIO position the signal from the output of the receiver is applied to the vertical amplifier of the oscilloscope.

When in the CAL. position the audio "beat" frequency produced by the AM Generator and Crystal Calibrator is applied to the vertical amplifier of the oscilloscope to provide a visual means of calibration.

The HORIZ. AMPL. cable connects to the Horizontal Amplifier of the oscilloscope to provide a synchronized 60 cycle sine wave sweep with variable Phasing.

CALIBRATION PROCEDURE FOR DETERMINING VARIOUS FREQUENCIES AT CRYSTAL ACCURACY

The Model 479 is provided with two precision vernier dials, one for the AM Generator and the other for the FM Generator. The AM Generator is used as a Marker Generator in FM and TV alignment and is therefore provided with a means for crystal calibration.

Although the accuracy of the AM Generator is better than 1% even greater accuracy is required when adjusting FM and TV receivers. For this reason the Model 479 is provided with a crystal oscillator standard having an accuracy of .05% or better. It is by use of this standard and the Logging Scale of the AM Generator section that frequencies of crystal accuracy may be established anywhere within the range of the AM Generator.

To prepare the Model 479 for calibration turn the POWER switch to OPERATE -- SIGNAL SELECTOR to CAL.-SIGNAL ATTENUATOR to 10-AM GENERATOR RANGE to A, B, or C depending on the frequency to be established. Connect the VERT. AMPL. cable to the vertical amplifier input of the Oscilloscope. With the Oscilloscope operating on its internal sweep or on the 60 cycle sine wave sweep available from the Model 479, advance the vertical amplifier gain control and slowly rotate the AM Generator tuning knob while observing the Oscilloscope screen. At various points along the dial a pattern will appear on the Oscilloscope screen. When the dial is moved slow enough the pattern will be seen to start at a very high frequency gradually decreasing in frequency to zero then gradually increase and finally disappear. This pattern is the result of the beat frequency developed between the AM oscillator and the 5 megacycle crystal oscillator.

The point at which the pattern reduces to ZERO FREQUENCY is known as zero beat and is the point at which the two oscillators are in step. The zero beat point is easily identified by the fact that the slightest movement of the dial in either direction will cause the pattern to increase in height and in frequency. At zero beat the pattern is essentially a straight line. At the higher frequencies it is sometimes difficult to bring the pattern to exact zero beat, but this is not important so long as it is brought down to within two or three hundred cycles.

It will be noted that some points on the dial will produce a much larger pattern on the Oscilloscope than at other points. This is due to the order of harmonics of the two oscillators which are producing the pattern; the lower harmonics result in a stronger beat pattern. Some of the weaker patterns may require a higher setting of oscilloscope VERTICAL GAIN control while some of the stronger may require a lower setting.

TABLE I - CRYSTAL CALIBRATING POINTS

BAND A				BAND B				BAND C			
FUNDAMENTAL MEGACYCLES	2ND HARMONIC MEGACYCLES	VAR. OSC. HARM.	XTL. OSC. HARM.	FUNDAMENTAL MEGACYCLES	2ND HARMONIC MEGACYCLES	VAR. OSC. HARM.	XTL. OSC. HARM.	FUNDAMENTAL MEGACYCLES	2ND HARMONIC MEGACYCLES	VAR. OSC. HARM.	XTL. OSC. HARM.
*3.33	*6.67	3	2	*15.00	*30.00	1	3	*70.0	*140	1	14
3.46	6.92	13	9	15.83	31.66	6	19	72.5	145	2	29
3.50	7.00	10	7	16.00	32.00	5	16	*75.0	*150	1	15
3.57	7.14	7	5	16.25	32.50	4	13	77.5	155	2	31
3.64	7.28	11	8	*16.67	*33.34	3	10	*80.0	*160	1	16
*3.75	*7.50	4	3	17.00	34.00	5	17	82.5	165	2	33
3.89	7.78	9	7	*17.50	*35.00	2	7	*85.0	*170	1	17
*4.00	*8.00	5	4	18.00	36.00	5	18	87.5	175	2	35
4.09	8.18	11	9	*18.33	*36.66	3	11	*90.0	*180	1	18
*4.17	*8.34	6	5	18.75	37.50	4	15	92.5	185	2	37
4.29	8.58	7	6	19.00	38.00	5	19	*95.0	*190	1	19
4.38	8.76	8	7	*20.00	*40.00	1	4	97.5	195	2	39
*4.44	*8.88	9	8	21.00	42.00	5	21	*100.0	*200	1	20
4.50	9.00	10	9	21.25	42.50	4	17	102.5	205	2	41
4.55	9.10	11	10	*21.67	*43.34	3	13	*105.0	*210	1	21
4.58	9.17	12	11	22.00	44.00	5	22	107.5	215	2	43
*5.00	*10.00	1	1	*22.50	*45.00	2	9	*110.0	*220	1	22
5.63	11.26	8	9	23.00	46.00	5	23	112.5	225	2	45
*5.71	*11.42	7	8	*23.33	*46.66	3	14	*115.0	*230	1	23
5.83	11.66	6	7	23.75	47.50	4	19	117.5	235	2	47
6.00	12.00	5	6	24.00	48.00	5	24	*120.0	*240	1	24
*6.25	*12.50	4	5	*25.00	*50.00	1	5	122.5	245	2	49
6.43	12.86	7	9	26.25	52.50	4	21	*125.0	*250	1	25
*6.67	*13.34	3	4	26.67	53.34	3	16				
6.87	13.74	8	11	*27.50	*55.00	2	11				
*7.00	*14.00	5	7	28.33	56.66	3	17				
7.14	14.28	7	10	28.75	57.50	4	23				
7.22	14.44	9	13	*30.00	*60.00	1	6				
*7.50	*15.00	2	3	31.67	63.34	3	19				
7.72	15.44	11	17	*32.50	*65.00	2	13				
7.78	15.56	9	14	33.33	66.66	3	20				
*8.00	*16.00	5	8	*35.00	*70.00	1	7				
				36.67	73.34	3	22				
				*37.50	*75.00	2	15				

ASTERISK (*) INDICATES THE STRONGER CALIBRATION POINTS.

Table 1 has been developed to assist in identifying the frequencies where beat patterns occur and the oscillator harmonics producing them. The frequencies preceeded by an asterisk* will produce the stronger patterns and should be used wherever possible.

-791

41.67-(397.4)

* 47.25 -(506.4)
45.75 - (481.2)
45.00 -(466.5)
3.8 (440.9
44.00 -(445.0)
3.50 (434.8)
cen of sound & pic
42.75- (419.5)
42.50-(414.5)
42.17-(407.5)
* 41.25-(388.9)
* 39.75-(355.5)

CH. 10 -193.25 -(357.5
372.55 cen
-197.75-(387.6)

4.5 (394.8)

CH. 13 - 211.25 -(482.2) P
497.3 cen
-215.75 - (512.4) S

CH. 4 - 67.25 (828.0) PIC
(861.6) CEN
71.75 (892.0) SOUN

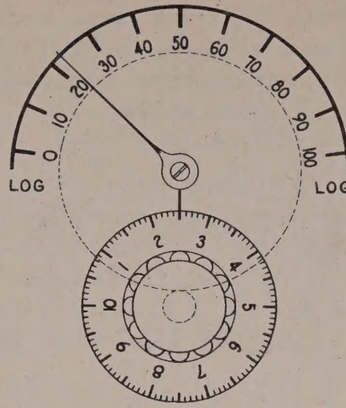

FIG. 2 THE MODEL 479 TV-FM LOGGING DIAL

Fig. 2 is an illustration of the logging arc of the AM Generator dial. The lower arc of this dial is divided into 10 equal divisions 0 to 100. Coupled to the knob shaft is another dial divided into 100 equal divisions and directly above it is an index line to which the Logging dial is set.

One complete revolution of the Logging dial will move the main pointer one complete division on the logging scale. Thus each division of the Logging scale is effectively divided into 100 parts or a total of 1000 divisions for the entire arc. In addition the minor divisions of the small dial may be visually divided to further increase the number of points. As an example, the position of the dial illustrated is 22.5. The main pointer is above 20 and the Logging dial is at 2.5; therefore the setting is registered as 22.5. If the Logging dial were setting half way between 2.5 and 2.6 we could register the setting as 22.55. Taking advantage of visual divisions of these points the setting accuracy is effectively increased to 2000 or more divisions.

DETERMINING AN EXACT FREQUENCY

There are two methods by which a given frequency setting may be obtained.

The first method to be described is the simpler of the two and while perhaps somewhat less accurate than the second and more involved system, it can with practice yield very acceptable results. As an example, let us assume that a frequency of 20.75 megacycles is desired. Referring to Table 1 we see that a strong check point is available at 20 megacycles. The next step is to determine the exact number of Logging dial divisions there are between the 20 MC and 21 MC points on the generator frequency arc. Looking at the frequency arc from a right angle position, rotate the tuning knob until the pointer is EXACTLY over center of the 20 MC division on the arc. Record the position of the Logging scale. Let us say this is 37.0. Looking at the frequency scale from exactly the same position, rotate the tuning knob until the pointer is EXACTLY over the center of the 21 megacycle division on the arc. Again record the position of the Logging scale, for example 41.2. Subtracting the first reading, 37.0, from the second, 41.2, we have a difference of 4.2 which represents the number of divisions of the Logging dial covering one megacycle in frequency. Since the desired frequency is 20.75 MC (20 + .75 MC) it is necessary to determine how many divisions are covered by .75 MC. Multiplying 4.2 divisions by .75 we find that 3.15 divisions on the Logging dial covers .75 megacycles. (4.2 x .75 = 3.15).

The next step is to determine the exact setting for 20 megacycles. Set the AM GENERATOR RANGE switch to range B and the SIGNAL SELECTOR to CAL. Move the main dial pointer to the vicinity of the 20 megacycle point until the beat pattern appears

on the oscilloscope screen. This will be the strongest signal in the vicinity. Bring the pattern to zero beat and record the setting. Let us say this is 36.5. Adding 3.15 divisions for the .75 megacycles we have 36.5 + 3.15 = 39.65, which is the Logging Scale setting for 20.75 megacycles.

To obtain a frequency BELOW the check point the same method can be used except that the increment is subtracted from the check point setting. Thus to obtain a setting for 19.75 megacycles a difference reading is taken between 20 MC and 19 MC. If this difference turns out to be 5.4 divisions for 1 megacycle, then .25 MC (20 - 19.75 = .25) would be 5.4 x .25 = 1.35. This subtracted from the setting established for 20 MC or 36.5 - 1.35 = 35.15, which is the Logging scale setting for 19.75 MC.

The second method of determining a given frequency involves Logging two crystal check points and calculating the setting for the desired frequency.

Let us assume the previous frequency of 20.75 MC is desired. Referring to Table 1 we find the two frequencies nearest 20.75 MC to be 20 MC and 21.67 MC. With the Signal Selector in the CAL. position tune the AM Generator for zero beat at the 20 MC point. The Log scale setting we will again assume to be 36.5. Next we tune the oscillator for zero beat at 21.67 MC and find the Log setting to be 43.45. The Log difference is 43.45 - 36.5 = 6.95. The frequency difference is 21.67 - 20 = 1.67. Therefore we have a difference of 6.95 Log divisions for 1.67 MC. The desired frequency of 20.75 MC is greater than 20 MC by .75 MC. Then by proportion

$\frac{.75 \text{ MC}}{1.67 \text{ MC}} = \frac{(X) \text{ divisions}}{6.95 \text{ divisions}}$ Multiplying both sides of the equation by 6.95 we have

$\frac{5.21 \text{ MC}}{1.67 \text{ MC}} = (X) \text{ divisions.}$ $X = 3.12$ divisions.

That is 3.12 divisions represents a frequency change of .75 MC. Adding 3.12 divisions to the original Log setting for 20 megacycles 36.5 + 3.12 = 39.62. The Log setting for 20.75 MC.

While check points of 20 MC and 21.67 MC were used in the example, still greater accuracy of interpolation may be had by using the 21 MC point. Care must be exercised when using the weaker signals for they are sometimes very close together and difficult to identify. It will be noted that the 21 MC point is produced by the 5th harmonic of the generator and the 21st harmonic of the crystal. This signal will therefore be much weaker than the 21.67 signal created by the 3rd and the 13th harmonics, and more Vertical Gain will be necessary to produce a beat pattern on the oscilloscope.

PRINCIPLES OF VISUAL ALIGNMENT

The visual method of adjusting resonant circuits has been developed in order to eliminate the tedious procedure of point by point measurements which would otherwise be necessary to determine the response characteristics of a tuned circuit or a number of tuned circuits such as used in radio and television receivers.

Referring to figure 3 it is obvious that a response curve can be traced by applying a signal of fixed amplitued to the input of the circuit and measuring the output voltage as the frequency of the generator is varied. This, of course, requires numerous measurements and is impractical for the purpose of circuit adjustment. The visual alignment procedure accomplishes the same result but is instantaneous. Here the generator frequency is varied above and below circuit resonance at a fixed rate.

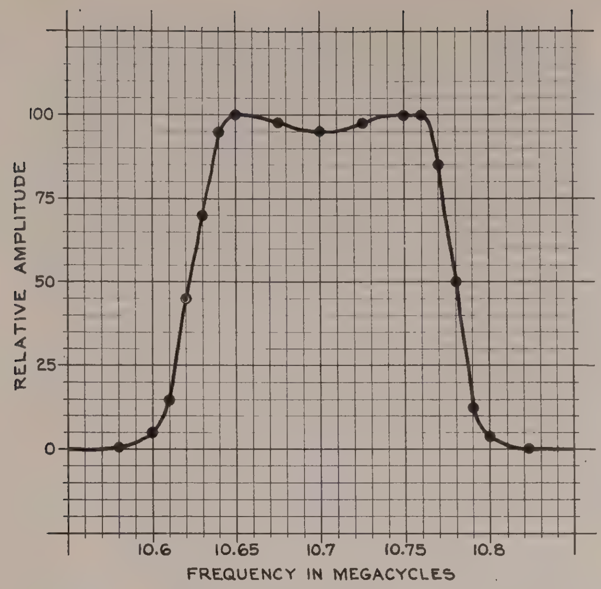

FIG. 3 GRAPHIC REPRESENTATION OF A RESPONSE CURVE

The vertical amplifier of an oscilloscope is connected across the output of the circuit in order to indicate the instantaneous voltage appearing at various points along the curve and the oscilloscope sweep is synchronized with the generator frequency deviation in such a manner that the entire resonant characteristic of the circuit is registered on the oscilloscope screen.

By this method the operator can instantly see the effects of the adjustments as he proceeds with the alignment.

This type of alignment is of particular value in television receivers because of the wide band characteristics necessary for satisfactory reception.

ALIGNMENT PROCEDURE

It would be impossible to cover all of the various alignment procedures in this manual since each receiver manufacturer determines the sequence of adjustment most suited to his particular product.

It is extremely important to follow the manufacturer's service instructions when making adjustments on Television receivers.

The following paragraphs will explain in detail the various steps in the alignment of a typical receiver and may be used as a guide for adapting the Model 479 to the manufacturer's alignment procedures.

The usual order of alignment is as follows:

1. Video IF Traps
2. Video IF Transformers
3. Sound Discriminator
4. Sound IF Transformers
5. RF Section

1. Connect the HORIZ. AMPL. cable of the Model 479 to the Horizontal Input terminals of the oscilloscope.

2. Connect the VERT. AMPL. cable to the Vertical input terminals.

3. Adjust the oscilloscope controls as follows:

Set the Horizontal Amplifier control switch in position to apply an external signal. (The internal scope sweep is not used for alignment.) Adjust the Intensity, Focus, Horizontal Centering, Vertical Centering and Horizontal Gain controls for a thin, bright trace which extends 2/3 to 3/4 the width of the CRT screen, centered horizontally and vertically. Set the Vertical Gain control to about 1/2 its range.

4. Set the FM GENERATOR RANGE switch to the OFF position.

5. Set the AM GENERATOR RANGE switch to B.

6. Set the SIGNAL SELECTOR switch to CAL. and the SIGNAL ATTENUATOR to 10.

NOTE: Allow the receiver and Model 479 to warm up for about 15 minutes before proceeding. (The Model 479 will not require the warm up period if it has been left in the STAND BY position.)

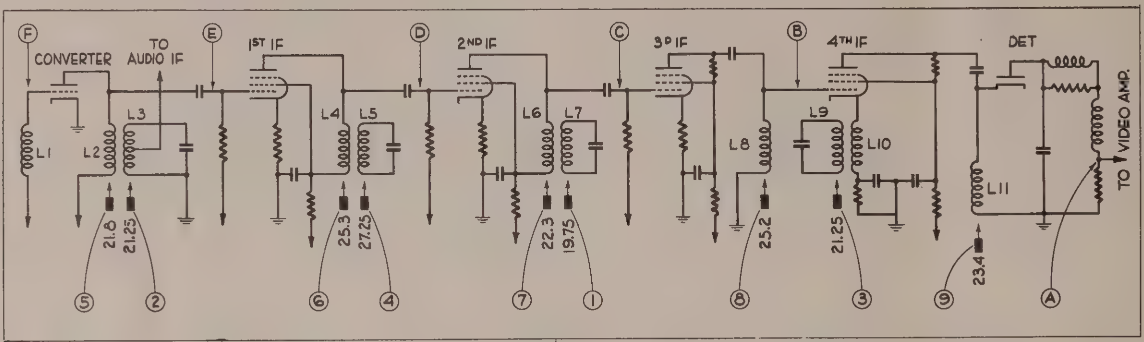

FIG. 4 TYPICAL TV PICTURE IF SYSTEM

7. Referring to the manufacturer's instruction sheet it is found that the first adjustment is that of the Adjacent Channel Video Carrier Trap at 19.75 MC. Follow the instructions given under CALIBRATION PROCEDURE in this manual to determine the exact dial setting for 19.75 megacycles. This setting should be recorded for future references. It is good practice to determine the dial settings for all frequencies specified in the alignment instructions before proceeding with the adjustment. Thus the alignment can be carried through without interruption. The frequencies specified in this example are: 19.75, 21.25, 21.8, 22.3, 23.4, 25.2, 25.3, and 27.25. See Fig. 4.

8. Set the OUTPUT cable Termination for SERIES CONDENSER output by connecting wire jumpers between terminals 2 and 3 and between terminals 4 and 5 of the termination box. (See Table 2).

Connect the Output cable to point F of Fig. 4. Ground lead to chassis. Connect the SIGNAL INPUT cable to point A Figure 4. Advance the receiver contrast control to about 3/4 of its range.

9. Rotate the SIGNAL SELECTOR to MOD. RF and adjust the SIGNAL ATTENUATOR, and OUTPUT ATTENUATOR and Oscilloscope Vertical Gain Control until a good size Lissajou pattern is obtained on the CRT screen.

The SIGNAL ATTENUATOR and OUTPUT ATTENUATOR should be operated at the lowest point possible for a good pattern in order to avoid overloading the amplifiers.

10. Set the AM Generator logging scale to the point recorded for 19.75 megacycles and adjust L7 (Point 1) Fig. 4 for MINIMUM pattern height. If the pattern disappears completely increase attenuator setting until the exact MINIMUM point can

be observed on the CRT screen.

11. Set the Logging Scale to the point recorded for 21.25 MC and adjust the Sound Takeoff Trap L3 (point 2) to MINIMUM indication on the CRT screen.

12. Leave the generator set at 21.25 MC and adjust the accompanying Sound Trap L9 (point 3) for MINIMUM indication.

13. Set the Logging Scale to the point recorded for 27.25 MC and adjust the Adjacent Channel Sound Trap L5 (point 4) for MINIMUM indication. This completes the trap adjustments.

14. Set the Logging Scale to the point recorded for 21.8 MC and adjust the converter output L2 (point 5) for MAXIMUM indication on the CRT screen. If the pattern becomes too large, reduce the SIGNAL ATTENUATOR or OUTPUT ATTENUATOR.

15. Set the Logging Scale to the point recorded for 25.3 MC and adjust the 1st IF L4 (point 6) for MAXIMUM.

16. Set the Logging Scale to the point recorded for 22.3 MC and adjust the 2nd IF L6 (point 7) for MAXIMUM.

17. Set the Logging Scale to the point recorded for 25.2 MC and adjust the 3rd IF L8 (point 8) for MAXIMUM.

18. Set the Logging Scale to the point recorded for 23.4 MC and adjust the 4th IF L11 (point 9) for MAXIMUM.

19. If coils L2, L4 or L6 have required appreciable adjustment, the associated traps L3, L5 and L7 should be re-checked as explained in steps 10, 11 and 13.

20. Occasionally a receiver will have a tendency to oscillate during alignment. This is usually caused by two or more transformers being tuned to the same frequency. Such oscillation will be identified by a sudden high deflection on the CRT screen and a scrambled pattern which cannot be controlled by the attenuators.

When this occurs the best remedy is to shunt points C, D, E and F with .001 Mfd. condensers, connect the Model 479 output to Point B and adjust L11. Remove the condenser at point C and connect the output cable to this point and adjust L8 and so on back to point F successively removing the condenser, and connecting the generator at points D, E, and F and adjusting L6, L4 and L2. Some manufacturers recommend the latter sequence of adjustment. It makes little difference which sequence is used so long as each stage is carefully adjusted to its assigned frequency.

21. With all of the trap and IF adjustments completed, we are now ready to view the overall response curve of the Video IF system.

22. Leave the Output cable of the Model 479 connected to the Converter grid (point F) and the Signal Input cable connected across the Video Detector load resistor (point A).

23. Set the SIGNAL SELECTOR switch to the OFF position. Set the FM GENERATOR RANGE switch to A - OUTPUT ATTENUATOR to MAX. - FM SWEEP to 5 - FM ATTENUATOR to 5 - PHASING to 0 - BLANKING to OFF. Set the FM Generator dial to approximately 23 MC on Range A. A response curve of the IF system should appear on the CRT screen.

Adjust the FM ATTENUATOR and the Oscilloscope Vertical Gain control for a

pattern of convenient height, keeping the FM Attenuator low as possible.

Adjust the PHASING control until the two traces are superimposed.

Re-adjust the tuning dial to bring the pattern into the center of the horizontal trace.

Re-adjust the FM Sweep control until the pattern includes at least two-thirds of the trace length.

Changing the FM Sweep control will necessitate re-setting the Phasing control.

Rotate the BLANKING control to where only a single trace appears and a straight base line across the pattern is obtained.

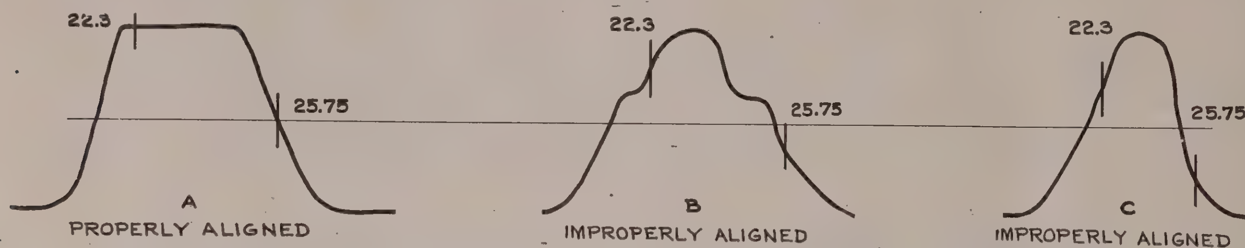

FIG. 5 PICTURE IF RESPONSE - STAGGER TUNED

24. Compare the pattern with that shown in the manufacturer's alignment instructions. See Fig. 5. If the system has been properly aligned, the pattern should resemble that of Fig. 5 "A".

25. Turn the SIGNAL SELECTOR switch to the UNMOD. RF position and set the Logging scale to the point recorded for 22.3 MC. A marker signal should appear on the pattern as shown in Fig. 5.

Note: It may be necessary to manipulate the SIGNAL ATTENUATOR, OUTPUT ATTENUATOR, FM ATTENUATOR and the OSCILLOSCOPE VERTICAL GAIN CONTROL in order to establish the proper relationship between the sweep generator output and the marker generator output.

A marker signal that is too strong will distort the response curve. If it is impossible to reduce the marker sufficiently with the Signal Attenuator then the FM Attenuator should be adjusted for a stronger signal, maintaining the pattern size by adjustment of the Oscilloscope Vertical Gain Control.

In extreme cases a harmonic of a lower frequency signal may be used. For instance the fourth harmonic of 5.56 megacycles could be used to obtain a marker at 22.3 mc.

Conditions may occasionally arise where insufficient marker signal is obtained. In such cases the exact opposite procedure to that above is used.

The Signal Attenuator should be operated at its maximum position and the FM output as low as possible, again adjusting the pattern size by means of the Oscilloscope Vertical Gain Control.

26. Set the Logging Scale to the point recorded for 25.75 MC and check the position of the marker. It should appear at 50% of the maximum height of the pattern.

27. Setting the Marker frequency to the various points to which the system was adjusted will indicate the part of the curve affected by each adjustment.

Slight re-adjustment of the system may be performed at these points in order to produce a satisfactory response curve. However, if considerable adjustment is necessary, the entire alignment procedure should be repeated.

The foregoing paragraphs have dealt with the alignment of a stagger tuned Video IF system. Another system known as Band Pass IF which is used in many receivers requires that the entire alignment be performed by use of the FM Generator. In this type of receiver the alignment begins with the last IF stage and proceeds back to the Converter. A set of curves is furnished as a guide and it is only neccessary to follow the sequence set up by the manufacturer's instructions using the

curves to indicate the type of response to be expected. A set of such curves is shown in Fig. 6.

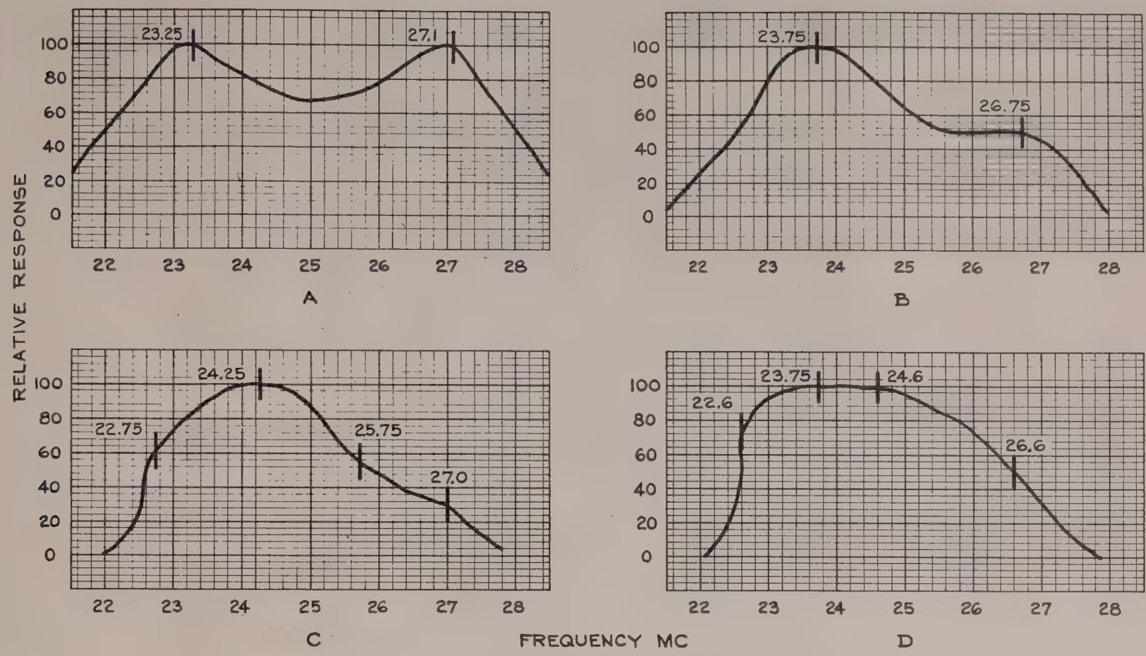

FIG. 6 PICTURE IF ALIGNMENT CURVES - BAND PASS TYPE

To adjust this type of IF connect the SIGNAL INPUT cable to the Video Detector output and the OUTPUT cable to the grid of the last IF amplifier tube. Set the FM GENERATOR RANGE switch to A and adjust the dial to 25 MC. Set the FM ATTENUATOR to 10. Adjust the VERTICAL GAIN control PHASING and BLANKING for a single image pattern of satisfactory height. Set the AM GENERATOR RANGE to B, SIGNAL SELECTOR to CAL. and record marker Frequencies for 22.6, 22.75, 23.25, 23.75, 24.25, 24.6, 25.75, 26.6, 26.75, 27.0, and 27.1 megacycles.

Set the SIGNAL SELECTOR to UNMOD. RF and the dial to the point recorded for 27.1 MC. Adjust the SIGNAL ATTENUATOR for a marker pip on the pattern. Always use the smallest possible marker by adjusting the SIGNAL ATTENUATOR. Adjust the Primary and Secondary of the last IF for a single peak centered on the 27.1 marker. Adjust the coupling condenser of this transformer for a peak at 23.25 MC, using the dial setting previously recorded. The curve should now resemble that of Fig. 6 "A".

Moving the Output cable to the next preceding amplifier grid, the Secondary of the stage is adjusted for a peak at 23.75 MC and the Primary at 26.75 MC. There is no coupling condenser adjustment for this stage. The resultant curve should be similar to Fig. 2 "B".

Moving the Output cable to the next preceding stage, adjust the Primary and Secondary for a curve having the same shape and relative amplitude as that of Fig. 6 "C", using markers at 22.75, 24.25, 25.75, and 27.0 MC.

Next, connect the Output cable to the Converter grid and adjust the Primary, Secondary and Coupling condenser for a curve resembling Fig. 6 "D", using markers at 22.6, 23.75, 24.6, and 26.6.

It is permissible to make slight touch-up adjustments to improve the overall response curve, but care should be exercised in selecting the adjustment which affects the part of the curve needing correction.

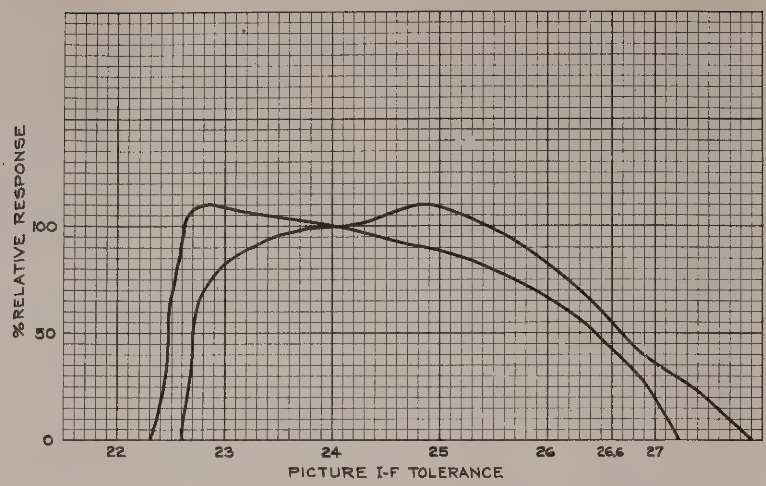

FIG. 7 RESPONSE TOLERANCE - BAND PASS IF

Fig. 7 shows the acceptable limits of the overall response curve and the alignment should be so conducted that a curve falling within these two extremes is obtained.

The preceding paragraphs have dealt only with the adjustments which affect the IF response curve. Trap adjustments have been purposely omitted since these adjustments are made exactly the same as those previously explained in steps 7 to 13. The trap adjustments should be made in the order recommended in the manufacturer's instructions with the FM Generator Range switch in the OFF position and the Signal Selector in the MOD. RF position. The specified trap frequencies should be logged in advance.

FM ALIGNMENT

The order of FM alignment usually begins with the Discriminator adjustment followed by the IF and then the RF section. There are exceptions to this, however, and it is again suggested that the sequence recommended in the manufacturer's alignment instructions be followed. The following paragraphs will deal with alignment of the sound section of a television receiver, but the same principles apply to an FM receiver except that the intermediate frequencies are usually lower.

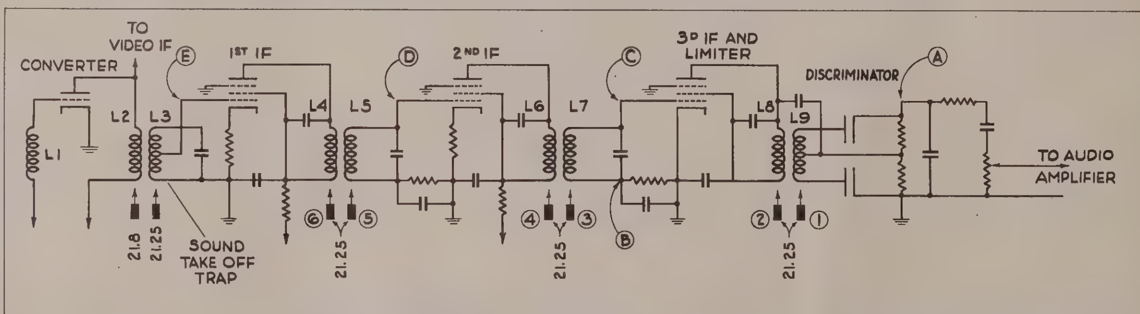

FIG. 8 TYPICAL TV SOUND IF SYSTEM

DISCRIMINATOR ALIGNMENT

Fig. 8 is the schematic of a typical sound IF system composed of 3 IF stages and a discriminator. The 3rd IF tube serves as a limiter to reduce the effects of amplitude modulation.

1. Connect the Model 479 OUTPUT cable between point C Fig. 8 and ground using SERIES COND. termination. (See Table 2)

2. Connect the SIGNAL INPUT cable between point A and ground.

3. Set the OUTPUT ATTENUATOR to MAX.-FM SWEEP to 1 -FM ATTENUATOR to 10 - PHASING to 0 - BLANKING to OFF - FM GENERATOR RANGE to A and the CENTER FREQUENCY dial pointer to 21.25 megacycles.

4. Set the OSCILLOSCOPE VERTICAL GAIN to 0 and adjust the INTENSITY, FOCUS, VERTICAL CENTERING, HORIZONTAL CENTERING and HORIZONTAL GAIN controls for a thin, bright trace extending approximately 3/4 the width of the screen and centered horizontally and vertically.

5. Advance the Vertical Gain Control until a response pattern of satisfactory height is obtained. The pattern will consist of two separate S shaped response curves. Adjust the PHASING control until the two curves are superimposed.

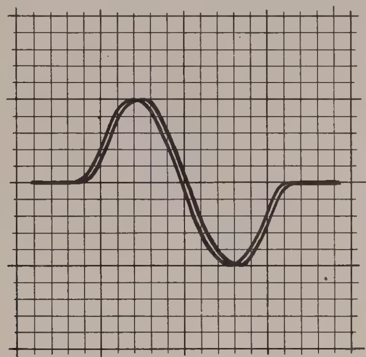

FIG. 9 DISCRIMINATOR RESPONSE - IN PHASE - BLANKING OFF

6. Advancing the FM Sweep will shorten the response curve and reducing it will lengthen the curve. The FM Sweep should be adjusted until the response curve covers most of the horizontal trace. See Fig. 9. (Changing the FM Sweep will require re-setting the Phasing.) Re-adjust the center frequency pointer slightly if necessary to position the response curve in the center of the horizontal trace. Adjust the BLANKING control until a single curve appears with a base line through it. See Fig. 10.

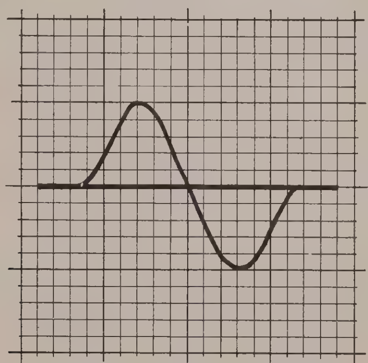

FIG. 10 DISCRIMINATOR RESPONSE - BLANKING ADJUSTED

7. The FM ATTENUATOR should be operated at the lowest possible point where a satisfactory pattern is obtained. As the Attenuator is reduced it will be necessary to increase the Vertical Gain control to maintain the same pattern height.

8. Set the SIGNAL SELECTOR to CAL. - AM GENERATOR RANGE switch to B - SIGNAL ATTENUATOR to 10 and adjust the frequency to exactly 21.25 megacycles as outlined under CALIBRATION PROCEDURE in this manual.

9. Rotate the SIGNAL SELECTOR to MOD. RF. If the Discriminator Secondary is not in perfect alignment, a 400 cycle modulation pattern should appear along the base line of the S curve. See Fig. 11.

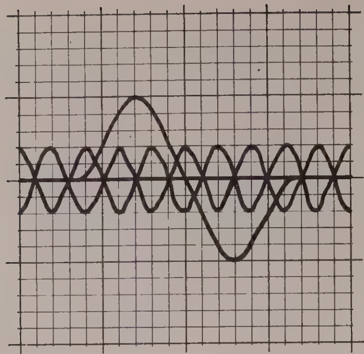

FIG. 11 DISCRIMINATOR RESPONSE - 400 CYCLE MODULATION

10. Adjust the Discriminator Secondary (L9 Fig. 8) to the point where the 400 cycle pattern disappears then reappears if the adjustment is continued in the same direction. It is important to make this adjustment to the EXACT NULL point keeping the SIGNAL ATTENUATOR at the lowest possible setting in order to avoid the broad response resulting from high signal amplitude.

11. Adjust the Primary of the Discriminator (L8 Fig. 8) for a symmetrical pattern of maximum amplitude having equal deflection above and below the base line such as that shown in Fig. 10. Reduce the FM ATTENUATOR setting as the height of the curve increases. If the Primary requires considerable adjustment the Secondary adjustment should be re-checked.

12. When the Discriminator alignment has produced a symmetrical S curve of maximum ampliture and the 400 cycle pattern reduced to exact null, connect the Signal Input cable between point B (Fig. 8) and ground. An isolating resistor of between 25,000 ohms and 50,000 ohms should be used between point B and the Signal Input cable.

13. Connect the Output cable to the grid of the Next preceding amplifier (point D).

14. Rotate the SIGNAL SELECTOR to UNMOD. RF. and adjust the FM ATTENUATOR and SIGNAL ATTENUATOR to obtain an IF response curve similar to that of Fig. 12. This curve may be considerably distorted if L6 and L7 are not in proper adjustment.

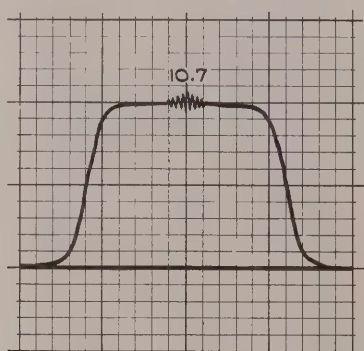

FIG. 12 SOUND IF RESPONSE

15. Adjust L7 and L6 Fig. 8 for a symmetrical response curve of maximum height such as that of Fig. 12 with a marker pip appearing at the center. Keep the FM Attenuator low as possible to avoid overloading and keep the Signal Attenuator low as possible to avoid distortion of the response curve at the marker point.

16. Connect the Output cable to the grid of the next preceding amplifier and adjust L5 and L4 for a symmetrical response curve of maximum height with the marker pip at center.

This completes the Sound IF adjustment since L2 and L3 were adjusted during the Video IF alignment. However, if this were an FM receiver instead of a TV receiver L2 and L3 would be adjusted to the receiver intermediate frequency in the same manner as the preceding adjustments with the Output cable connected to the Converter grid. As the alignment progresses from the Discriminator back to the Converter the width of the response curve will decrease since the selectivity of the entire amplifier is greater than that of any one stage. If the response curve becomes too small the FM SWEEP should be reduced. Any change in sweep width will require re-adjustment of the PHASING control. The Phasing control must be adjusted with the BLANKING control in the OFF position.

If it is desired to check the band pass of the IF system the OUTPUT cable is connected to the grid of the Converter tube and the marker pip moved from one side of the trace to the other by varying the frequency of the AM Generator.

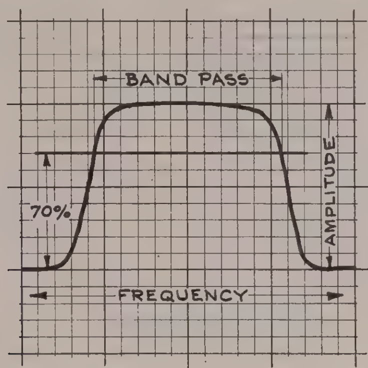

FIG. 13 IF BAND PASS MEASUREMENT

The band pass of a resonant circuit is usually taken at the 70% of maximum response points. See Fig. 13. Thus to check the band pass of the IF system, place the marker pip at the 70% point on one side of the trace. Record the setting of the Logging dial. Move the marker to the 70% point on the opposite side and record the setting. If the exact band pass is desired, determine the frequency covered between the two settings as explained in CALIBRATION PROCEDURE. However, if such accuracy is not required the difference can be determined directly from the frequency arc of the AM Generator.

TELEVISION TUNER ALIGNMENT

RF section alignment procedures are many and varied in Television receivers depending upon the internal construction of the tuner unit. Some tuners employ independent tuning circuits for each channel, each of which may be adjusted, without effect on other channels, while other systems employ a series of inductances interconnected in such a manner that adjusting one channel may affect another. This type of tuner requires a certain sequence of adjustment in order to avoid de-tuning channels previously adjusted. A third type of circuit employs a continuously variable tuner which is adjusted at one frequency and depends upon precision tracking of the tuner to maintain alignment throughout the various channels.

Many manufacturers provide decoupling networks in the tuner section to which an oscilloscope may be connected during alignment. On other receivers the oscilloscope must be connected across one of the detectors or to the plate of the converter tube. The latter method requires some means of demodulation. The circuit of an easily constructed crystal demodulator is shown in Fig. 17.

In order to simulate actual operating conditions it is important that the receiver input impedance match that of the generator output.

The Model 479 Output cable is terminated in such a manner that the impedance match can be accomplished quickly. See Fig. 14 and Table 2.

TABLE 2 - TERMINATION BOX CONNECTIONS

TERMINATION	CONNECTIONS	
300 ohms	Jumper 1-2	Jumper 5-6
150 ohms	Jumper 1-2 Jumper 5-6	50 ohms 2-3 75 ohms 4-5
75 ohms	Jumper 1-2-3	Jumper 4-5-6
50 ohms	Jumper 1-2 Jumper 4-5	30 ohms 2-3 50 ohms 1-5
Open Termination	Jumper 1-2-3	Jumper 4-5
Series Condenser .02 mfd 400 V	Jumper 2-3	Jumper 4-5

The two most commonly used impedances, 75 ohms and 300 ohms, are available by simply connecting wire jumpers between the terminals as shown in Table 2.

To obtain 50 ohms or 150 ohms it is necessary to connect non-inductive resistors across certain terminals and jumpers across others.

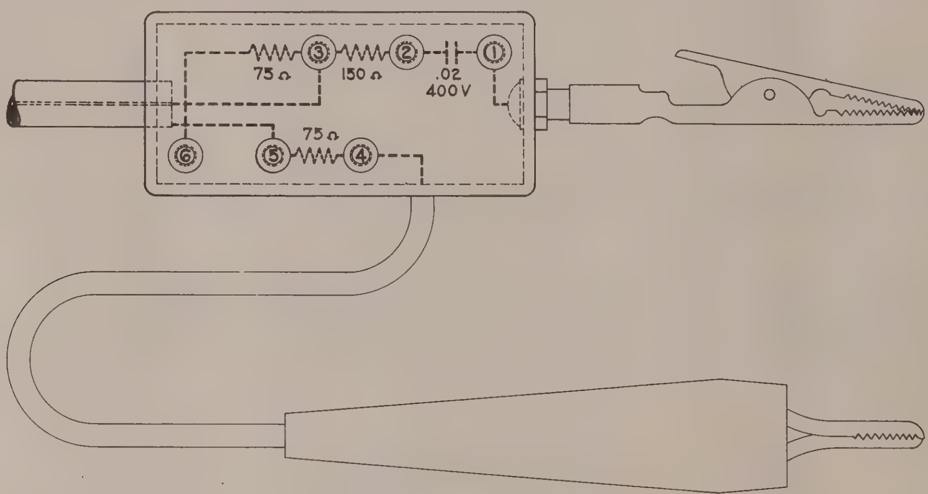

FIG. 14 IMPEDANCE MATCHING OUTPUT CABLE

To obtain other impedances, connect a jumper across terminals 5 and 6. This terminates the Output cable at its characteristic impedance of 75 ohms. Subtract the 75 ohms from the desired impedance to obtain the amount of resistance to be added. This additional resistance may be connected externally or the internal resistors may be used by shunting them with suitable values. As an example, assume an impedance of 200 ohms is desired. Connect a jumper across terminals 5 and 6 to terminate the cable at 75 ohms. Then 200 - 75 = 125 ohms is the resistance to be added. From Fig. 14 we find that there is 75 ohms in the ground leg (terminals 4 and 5). If the 75 ohms between terminals 4 and 5 is used an additional 50 ohms is needed and this may be had by shunting the 150 ohms between terminals 2 and 3 with a 75 ohm resistor. We now have 50 + 75 + 75 = 200 ohms across the receiver input and 75 ohms across the generator output, thus the system is said to be matched.

Terminals 1 and 2 should be shorted with a jumper in order to eliminate the .02 mfd condenser.

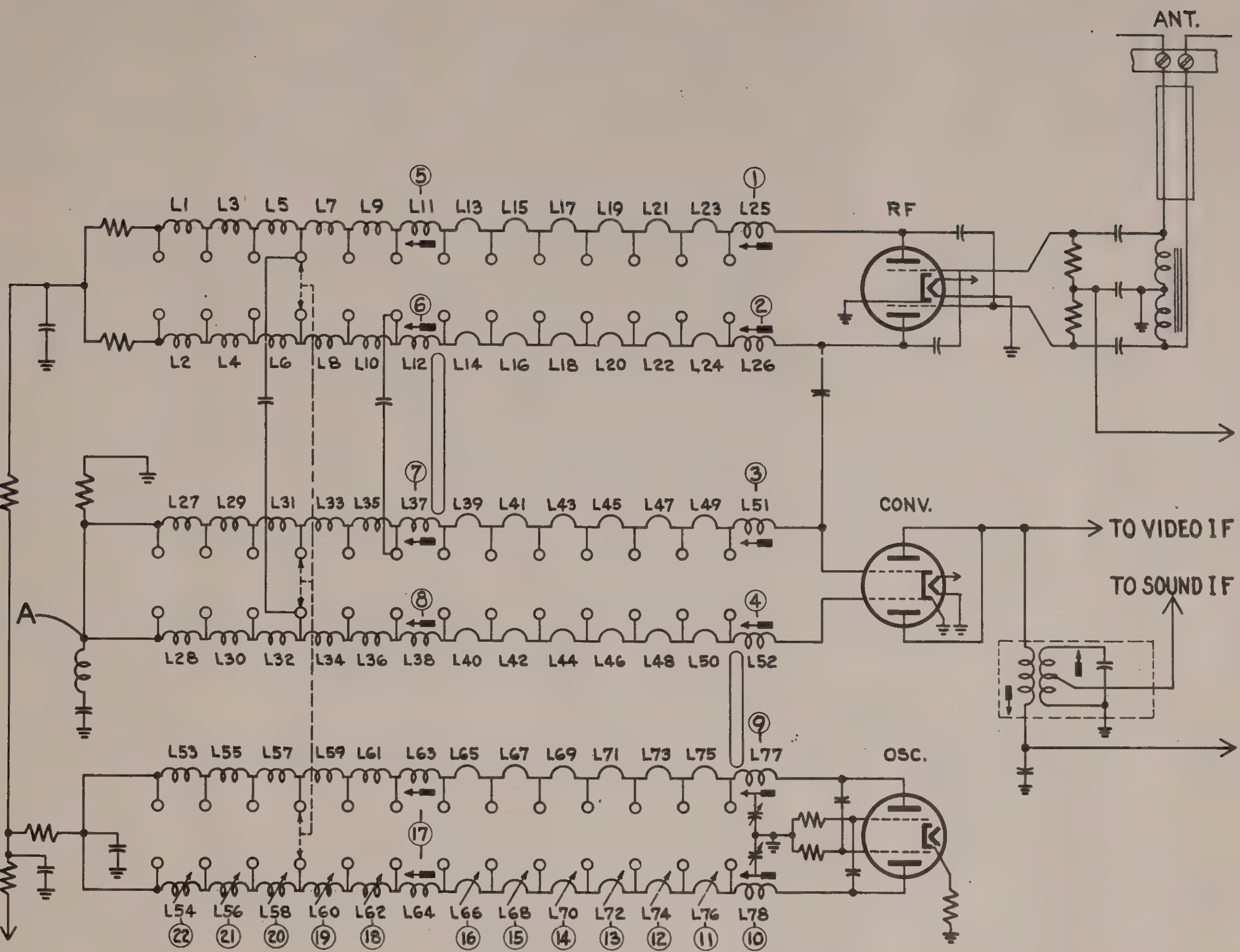

FIG. 15 TYPICAL TV TUNER

Fig. 15 shows one type of TV Tuner and will be used as an example of tuner alignment. The design of this tuner requires that the high frequency channels be adjusted first and since channel 7 presents the narrower response it is adjusted first.

1. Connect the SIGNAL INPUT Cable of the Model 479 between point A (Fig. 15) and ground through a 10,000 ohm carbon resistor.

2. Set the OUTPUT cable termination for 300 ohms by connecting wire jumpers between terminals 1 and 2 and between terminals 5 and 6 of the termination box (see Table 2). Connect the terminated Output cable across the antenna input terminals of the receiver.

3. Set the receiver contrast control for a bias of 1.5 volts at the RF stage and the Channel Selector to channel 7.

4. Set the FM GENERATOR RANGE to B and the pointer to 177 MC (center of channel 7).

5. Set the OUTPUT ATTENUATOR to X1000 and adjust the FM SWEEP, FM ATTENUATOR, PHASING and BLANKING controls together with the Oscilloscope VERTICAL GAIN and HORIZONTAL GAIN controls for a response pattern of satisfactory proportions.

6. Log marker frequencies for 175.25 and 179.75 MC (picture and sound carrier frequencies for channel 7).

7. Using markers at the above frequencies adjust L25, L26, L51, and L52 (Points 1, 2, 3 and 4 Fig. 15) for a curve of maximum height approximating that of Fig. 16. This curve normally appears somewhat overcoupled with a 10 to 15% dip at the center with the markers at approximately 90% of maximum response. The markers should never fall below the 70% point.

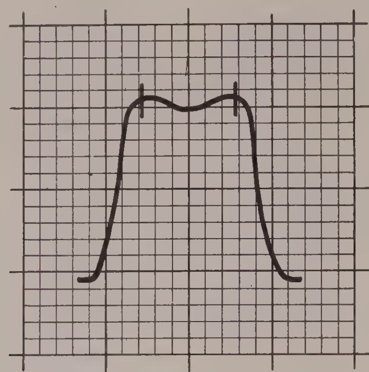

FIG. 16 TV TUNER RESPONSE

8. Check channels 8 through 13 for properly shaped response curves with picture and sound carrier markers for each channel above the 70% point. There are no individual adjustments for these channels and where response for any channel is found to be below 70% a compromise setting for L25, L26, L51 and L52 must be made.

9. Set the receiver selector for Channel 6 and the FM GENERATOR to 85 MC on band A (center of channel 6).

10. Adjust L11, L12, L37 and L38 for a symmetrical curve with markers above the 70% point.

11. Check channels 5, 4, 3 and 2 using the center frequency for each channel with marker frequencies for the picture and sound carriers for each.

12. Make a compromise setting of the previous adjustments if necessary. On final adjustment all channels should be within the 70% specification.

OSCILLATOR ALIGNMENT

There are several methods for making the oscillator adjustment of a TV Receiver. The simpler and most effective method is by use of the sound channels.

1. With the Output Cable connected to the antenna terminals of the receiver and the FM Generator turned off, connect the Signal Input cable across the Sound Discriminator output (point A Fig. 8).

2. Set the receiver selector to Channel 13 and the AM Generator section of the Model 479 to 215.75 MC using the Logging scale to determine the exact setting. Set the Signal Selector to Mod. RF and Signal Attenuator to 10.

3. Set the receiver Fine Tuning control to the center of its range.

4. Adjust L77 and L78 (points 9 and 10 Fig. 15) to a point where the 400 cycle pattern on the oscilloscope disappears and then reappears as the adjustment is continued in the same direction. Leave the adjustment at the EXACT NULL point. It may

be necessary to adjust the Signal Attenuator and the Oscilloscope Vertical Gain controls to obtain a sharp indication of the null point.

5. Adjust each lower channel in turn, setting the Generator frequency for the Sound Carrier frequency of each successive channel and adjusting for Null indication on the oscilloscope. This includes steps 11 through 22 of Fig. 15.

An alternate method is to use a zero center vacuum tube voltmeter connected across the Discriminator output as a Null indicator. In this case an Unmodulated RF input to the receiver should be used.

Another alternative is to use a high frequency probe (such as that shown in Fig. 17) connected to the plate of the Converter tube through a 10 MMF condenser and the Model 479 Output cable connected at the same point through another 10 MMF condenser. With this method the AM Generator tuner is set to the RECEIVER OSCILLATOR frequency and adjusted for "zero beat" indication on the oscilloscope. The RECEIVER OSCILLATOR frequency is determined by adding the Sound IF to the Sound Carrier frequency. Thus the Oscillator frequency for Channel 13 of the receiver under discussion would be 215.75 + 21.25 = 237 MC.

FM TUNER ALIGNMENT

Since the FM Discriminator and IF alignment procedure have been fully covered, the following paragraphs will deal only with alignment of the RF section of the FM Receiver.

The Tuner Section of most FM Receivers provide for adjustment at only one frequency and this is usually near the high frequency end of the dial. However, some are provided with a low frequency adjustment as well. It is therefore advisable to refer to the manufacturer's instructions for the recommended frequency or frequencies.

1. Connect the Signal Input cable across the grid leak of the last IF amplifier tube. Point B Fig. 8.

2. Connect the Output Cable through its matching network to the Antenna Terminals of the receiver. See Table 2.

3. Set the AM Generator to a frequency near the high frequency end of the receiver dial and set the receiver dial to the same frequency.

4. Set the Signal Selector switch to Mod. RF and adjust the Signal Attenuator, Output Attenuator and Oscilloscope Vertical Gain controls for a 400 cycle pattern of satisfactory height.

5. Adjust the Oscillator, Mixer, and RF trimmers for a pattern of maximum amplitude. Keep the Attenuators as low as possible for a usable pattern.

An alternative method is to use a frequency modulated signal input to the antenna and a marker signal set at the desired frequency, adjusting the Oscillator, Mixer and RF trimmers for a symmetrical response curve of maximum amplitude with the marker pip in the center of the curve.

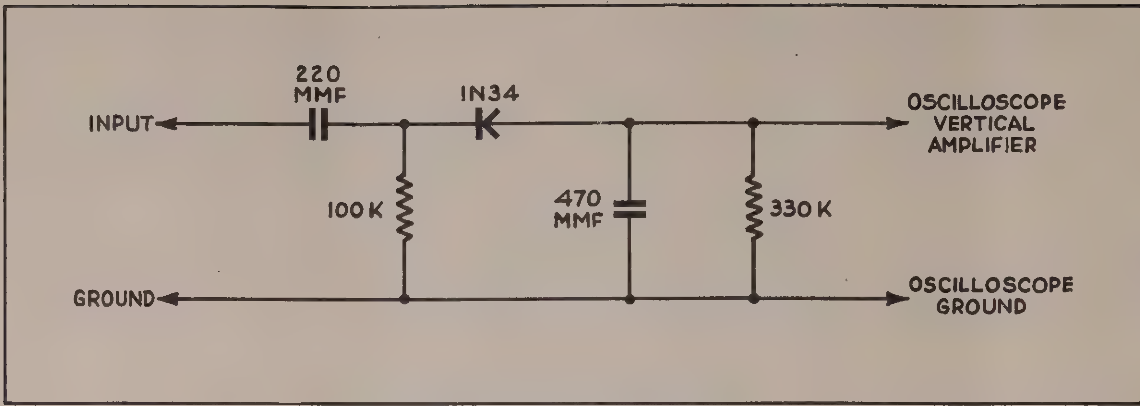

FIG. 17 HIGH FREQUENCY OSCILLOSCOPE PROBE

SIGNAL TRACING

The High Frequency Oscilloscope probe shown in Fig. 17 provides an excellent means for tracing the signal through an FM or TV receiver. The HF Probe is essentially a high frequency detector and may be used to pick up the signal from any part of the system where high frequencies exist.

To trace a signal through the sound channels of a TV receiver, connect the Output cable to the antenna terminals of the receiver and set the AM Generator to the Sound carrier frequency of the Channel being tested and the Signal Selector to Mod. RF.

Attach the High Frequency Probe cable to the Signal Input jack and connect the probe between various points along the IF system and ground. Starting with the Converter Grid the signal may be picked up on down through the IF System to the Discriminator with an increase in amplitude of the 400 cycle modulation pattern as each successive stage is checked.

The same test may be applied to the Picture system by tuning the Generator to the Picture Carrier frequency and proceeding from the converter tube through the Picture IF to the Video Detector.

Any single stage may be checked by connecting the HF probe across the output of the stage under test and injecting a signal of proper frequency to the input.

NOTE: High Frequency Oscilloscope Probe No. 10-890025 is available to Model 479 owners at a nominal cost.

TESTING THE AUDIO AMPLIFIER

The Model 479 includes a 400 cycle audio signal for the purpose of making tests in the audio amplifier section of a receiver. The 400 cycle signal is generated when the Signal Selector is in the AUDIO position and its amplitude is regulated by the SIGNAL ATTENUATOR and OUTPUT ATTENUATOR. This feature is of special value when it is desired to make tests in the Audio amplifier only.

To test the Audio amplifier connect the Output Cable across the Discriminator Output. Turn the Volume control to the full on position. With the Signal Selector in the AUDIO position and the attenuators set for a good oscilloscope indication, connect the Signal Input cable across the various points to be checked from the Discriminator back to the Speaker, noting the increase in signal strength as the test progresses and observing any wave form distortion which may occur.

The wave form will be best observed when the Oscilloscope Linear Sweep is used (Int. Sync. position) with the Sweep Range and Range Frequency controls set for a few cycles of the 400 cycle signal.

The approximate gain of each stage may be determined by use of the Output Attenuator and Signal Attenuator. The Signal Attenuator is linear and the Output Attenuator increases in multiples of ten from X 1 to X 1000.

As an example, suppose the amplitude of a signal at the grid of a tube is such that the Output Attenuator is at X 100 and the Signal Attenuator is at 10 with the Vertical Gain of the oscilloscope adjusted for a given size of pattern on the screen. Moving the Vertical Input cable to the plate of the tube it is found that to obtain the same size pattern it is necessary to reduce the Output Attenuator to X 10 and the Signal Attenuator to 5. The Output Attenuator has reduced the signal to 1/10 of its original value and Signal Attenuator has reduced it to 1/2 of that. Therefore the total reduction is 1/20 of the original signal and the gain of the stage is 20. That is, 1/.5 x 10 = 20. Had the Signal Attenuator been reduced to 2 the gain would be 1/.2 x 10 = 50 etc.

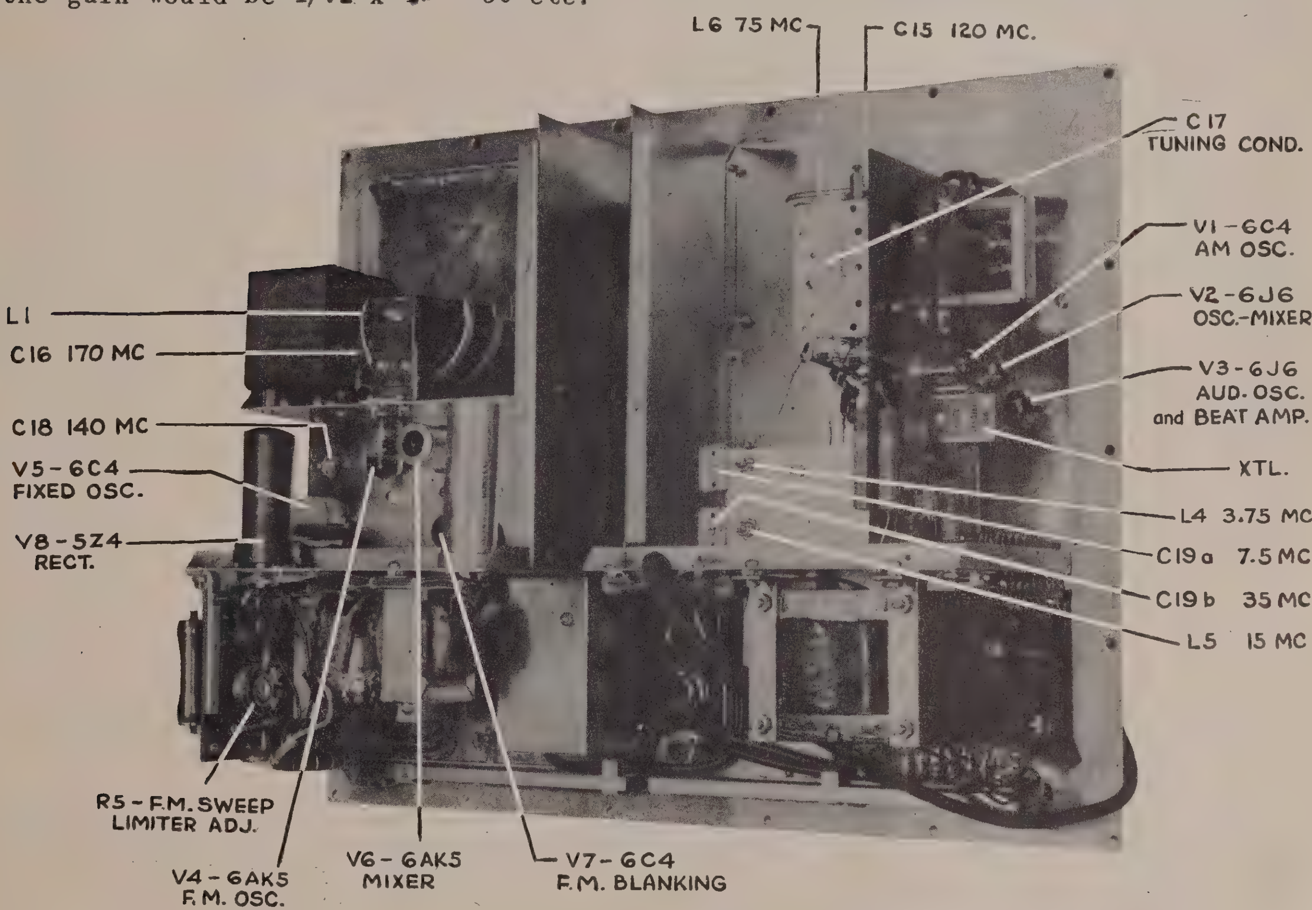

FIG. 18 REAR VIEW OF MODEL 479 - CASE & SHIELDING REMOVED

MAINTENANCE

The Model 479 is mounted to its case by 18 screws around the edge of the front panel. Removing these 18 screws will allow the assembly to be removed from the case. Fig. 18 is a rear view of the Model 479 with its case and internal shielding removed.

The FM Tuner Unit and four tubes are available when the rear cover of the FM section is removed. This includes the 6AK5 FM Oscillator, 6C4 fixed oscillator, 6AK5 mixer and 6C4 Blanking tube.

The AM Tuner, Crystal Calibrator, Audio Oscillator and three additional tubes are available by removing the rear cover of the AM section. The tubes in this section include the 6C4 AM oscillator, 6J6 Crystal Oscillator and Mixer, and the 6J6 Audio Oscillator and Beat amplifier.

The tubes of the Model 479 should be checked occasionally in order to insure good performance. The Model 479 is carefully adjusted at the factory by means of precision standards but due to the nature of Very High Frequency circuits, ageing of parts or replacement of tubes may require readjustment of the oscillator circuits in order to maintain original accuracy.

The Model 479 may be adjusted against its own crystal calibrator as follows:

1. With the back and top shields removed from both oscillator sections turn the Power Switch to OPERATE and allow the Model 479 to warm up for at least 15 minutes.

2. Set the Model 479 controls as specified under CALIBRATION PROCEDURE in this manual.

3. With the AM GENERATOR RANGE switch at A, tune the Oscillator until the 7.5 MC beat is indicated on the Oscilloscope.

4. Adjust C19A until the 7.5 MC zero beat appears at the 7.5 MC point on the scale.

5. Tune the oscillator for the 3.75 MC beat and adjust L4 until the beat appears at the 3.75 MC point on the dial. Re-check at 7.5 MC.

6. Switch to Band B and adjust C19B at 35 MC.

7. Set Oscillator for 15 MC and adjust L5. Re-check at 35 MC.

8. Connect a high frequency probe (Fig. 17) to the signal input jack and connect it to the Output cable termination box using OPEN TERMINATION (Table 2).

9. Log the setting for 170 MC and set the Signal Selector switch to Unmod. RF.

10. Set the FM Generator Range switch to B - FM sweep to zero - Blanking to zero - Output Attenuator to MAX.

11. Adjust the FM Oscillator about the 170 MC point until the beat between the two oscillators is observed on the oscilloscope, adjusting the FM Attenuator and Signal Attenuator as needed.

12. Adjust C16 until the beat is obtained at the 170 MC point on the FM dial.

13. Log the setting for 35 MC and return the Signal selector switch to Unmod. RF.

14. Set the FM Generator Range to A. Set the dial pointer to the high frequency end.

15. Rotate the AM Generator tuning pointer about the 35 MC point until a beat with the 140 MC fixed oscillator is observed.

16. Adjust C18 until zero beat is obtained with the AM Generator dial set at the point Logged for 35 MC.

17. Replace the top shield of the FM section and the back shield. Leave the top of the AM section open.

18. Turn the FM Generator Range switch to the OFF position - AM Generator Range switch to C - Signal Selector to CAL. Adjust C15 at 120 MC.

L6 should not require adjustment unless its original setting has been disturbed. In this case, the two set screws holding L6 in place should be loosened and L6 shifted in or out to obtain zero beat at 75 MC. Re-check at 120 MC.

19. Replace the top shield of the AM section.

SWEEP ADJUSTMENT

The FM Sweep Motor is adjusted at the factory to provide a sweep of plus or minus 7.5 MC when operated on 110 volts 60 cycles and the FM Dial set for 160 MC.

Operation on lower line voltages or line frequencies other than 60 cycles will require re-setting of the sweep limiter adjustment R5.

To make this adjustment set the FM SWEEP Control to 10 and adjust R5 until the desired sweep width is obtained.

This adjustment may be made against an IF or RF amplifier of known characteristics or a TV receiver IF system may be used and the band width established with a marker from the AM section.

CAUTION: Do not adjust the sweep beyond the 7.5 MC point. The motor reaches the limit of its swing somewhat beyond this point and damage may result if it is allowed to strike the stops for any considerable period of time.

MODEL 479 TUBE COMPLIMENT

TYPE	FUNCTION	CIRCUIT REFERENCE
6C4	AM Oscillator	V1
6J6	Crystal Oscillator & Mixer	V2
6J6	Audio Oscillator & Beat Amplifier	V3
6AK5	FM Oscillator	V4
6C4	140 MC Fixed Oscillator	V5
6AK5	Mixer (FM section)	V6
6C4	Blanking (FM Oscillator)	V7
5Z4	Rectifier	V8

PARTS LIST MODEL 479

		CIRCUIT REFERENCE
1-113870	Potentiometer 1 meg	R1
1-113873	Potentiometer 500 K	R2
1-113877	Potentiometer 50 K	R3
1-113880	Potentiometer 2K/2K	R4
1-113881	Potentiometer 10 ohms	R5
1-113882	Potentiometer 50 ohms	R6
1-113883	Switch -- Power	SW3
1-113884	Switch -- Signal Selector	SW2
1-113885	Switch -- FM range	SW4
1-113886	Switch -- Output Attenuator	SW5
1-113889	Switch -- AM range	SW1
1-113912	Condenser 100 mmf Ceramic	C1
1-113854	Condenser 220 mmf Ceramic	C2
1-113978	Condenser 470 mmf Ceramic	C3
1-113855	Condenser 2000 mmf Ceramic	C4
1-113913	Condenser 5000 mmf Ceramic	C5
1-113893	Condenser 3.3 mmf Ceramic	C6
1-113894	Condenser 7.5 mmf Ceramic	C7
1-113895	Condenser 10 mmf Ceramic	C8
1-113896	Condenser .01 mfd 400V Paper	C22
1-113898	Condenser .02 mfd 400V Paper	C9
1-113899	Condenser .05 mfd 400V Paper	C10
1-113900	Condenser .05 mfd 600V Paper	C20
1-113902	Condenser .1 mfd 400V Paper	C11
1-113903	Condenser .25 mfd 400V Paper	C12
1-113911	Condenser 8200 mmf Mica	C13
1-113963	Condenser 40-10 mfd 350V Electrolytic	C14
1-113914	Trimmer Condenser 3-12 mmf	C15
1-113915	Trimmer Condenser 2-6 mmf	C16
1-113916	Tuning Condenser 2 gang	C17
1-113920	Tuning Condenser 3.5-15 mmf	C18
1-113891	Trimmer Condenser 2.2-20 mmf	C19
1-113919	Resistor 7000 ohms 20W	R7
1-113979	Resistor 7500 ohms 5W	R8
1-113954	Resistor 6800 ohms 2W	R9
1-113955	Resistor 6.8 ohms 2W	R10
1-113956	Resistor 8200 ohms 2W	R11
1-113957	Resistor 10K 2W	R12
1-113958	Resistor 12K 2W	R13
1-113959	Resistor 22K 2W	R14
1-113960	Resistor 33K 5% 2W	R15

		CIRCUIT REFERENCE
1-113961	Resistor 33K 10% 2W	R16
1-113929	Resistor 680 ohms 1W	R17
1-113930	Resistor 2200 ohms 1W	R18
1-113931	Resistor 2700 ohms 1W	R19
1-113935	Resistor 56K 1W	R20
1-113921	Resistor 47 ohms ½W	R21
1-113922	Resistor 82 ohms ½W	R22
1-113923	Resistor 91 ohms ½W	R23
1-111940	Resistor 100 ohms ½W	R24
1-113924	Resistor 120 ohms ½W	R25
1-113925	Resistor 130 ohms ½W	R26
1-113926	Resistor 150 ohms 10% ½W	R27
1-113927	Resistor 150 ohms 5% ½W	R28
1-113928	Resistor 220 ohms ½W	R29
1-111684	Resistor 750 ohms ½W	R30
1-111689	Resistor 1K ½W	R31
1-113941	Resistor 2.2K ½W	R32
1-114057	Resistor 3.6K ½W	R40
1-114058	Resistor 4.7K ½W	R41
1-113048	Resistor 6.8K ½W	R56
1-111671	Resistor 10K ½W	R33
1-113943	Resistor 18K ½W	R34
1-113439	Resistor 22K ½W	R35
1-113945	Resistor 33K ½W	R36
1-113949	Resistor 100K ½W	R37
1-113951	Resistor 510K ½W	R38
1-111693	Resistor 10M ½W	R39
1-113950	Resistor 330K ½W	R61
1-113942	Resistor 2.7K ½W	R55
1-113947	Resistor 56K ½W	R59
1-113965	Crystal 5MC .05%	XTL
1-113966	Crystal socket	
1-113986	Tube socket, miniature	
1-114028	Tube socket, miniature	
1-112746	Tube socket, miniature	
1-112809	Tube socket, octal	
1-114027	Tube shield, short	
1-112747	Tube shield, long	
1-113982	Chassis Connector, female	J1
1-113983	Chassis Connector, male	J2

		CIRCUIT REFERENCE
0-008370	Output Cable	
0-008371	Oscilloscope Cable	
1-113972	Pilot socket assembly Ruby	
1-113973	Pilot socket assembly Green	
1-113852	Crystal diode 1N34	1N34
1-112529	Line Cord shielded	
10-890026	Dial assembly-FM	
10-890027	Dial assembly-AM	
3-260180	Knob, pointer	
1-114050	Knob, tuning	
10-890028	Coil assembly - FM tuner	L 1
10-890029	Coil assembly - Mixer coupling	L 2
10-890030	Coil assembly - Fixed Oscillator	L 3
10-890031	Coil assembly - Band A-RF	L 4
10-890032	Coil assembly - Band B-RF	L 5
10-890033	Coil assembly - Band C-RF	L 6
10-890034	R.F. Choke 85 uh	L 7
10-890038	Transformer-Plate	T 1
10-890044	Transformer-Filament	T 2
10-890037	Transformer-Modulation	T 3
10-890039	Filter Choke	L 8
10-890040	Line Filter Choke	L 9
22-302118	Modulation Motor assembly	M